Under the Ceiba Tree

Lessons from Designing Information and Communication Technology to promote health equity in Rural Latin America

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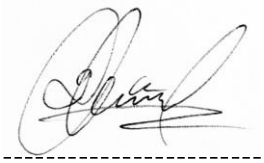

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Foreword

For as long as I remember, my life's goal has been to empower people through technology. As a software engineer with experience in the development of applications for the web and mobile devices for over 10 years, I felt that I could leverage those skills to make a contribution to improve society at large. In the fall of 2011, after leaving yet another tech company, I was searching for a larger purpose for my life and this motivated me to look for a better understanding of how I could help others, which the following year led me to the Masters of Environmental Studies at York University.

My plan of study was developed to explore how technology could improve the health of rural communities and I naively set out to create a technical innovation that would fill a gap in the health care system.

I was born in Mexico and raised in a rural community so I thought I had a good understanding of what the experience of other people living in rural communities in Mexico was like. Still I completed an Introduction to Rural Communities course, which was a self-directed study where I learned a lot about unique challenges in indigenous communities in Mexico and the tremendous diversity of these communities. I expanded my point of view in the summer of 2013 through a field experience course in Costa Rica where I witnessed several different examples of how people adapt to and simultaneously mould their environment.

I learned about the state of the art in current eHealth technologies, which I first understood as the use of machines and computer-based technologies in health care (Tan, 2005). I had the fortune to lead the development of an interactive, computer assisted, screening (iCAS) tool for

depression, which was commissioned for a randomized controlled trial led by Dr. Farah Ahmad and I earned hands on experience with a real world eHealth application.

Thanks to wonderful courses like “Health and the Environment” and the guidance of great professors like Dr. Sarah Flicker, I learned that “environmental conditions create risks, which are far greater to health than any present inadequacy of the health care system” (Lalonde, 1974). In his seminal report, Canadian Minister of Health Marc Lalonde revealed a misalignment in the focus of government expenditure and the relevant factors to improve population health. Sadly, almost 40 years later not much has changed. I perceive an opportunity to demedicalize society’s view on health through the power of information and communication technologies (ICTs).

In the fall of 2013, incredible fortune led me to complete an internship at the Centre for Global eHealth Innovation where Dr. Alex Jadad, one of the foremost authorities in the field and holder of the Canada Research Chair in eHealth Innovation, opened my eyes to a whole new conceptualization of health. Dr. Jadad eventually became my supervisor, coached me and mentored me throughout this project.

This major project aims to add a new type of ICT application, one that empowers people, as individuals and community members, by providing them with tools to improve their ability to identify their unmet needs, and to increase their capacity to adapt, to self-manage and to build resilience when facing physical, mental or social challenges.

I designed a web tool to support the execution of Max-Neef’s fundamental human needs assessment methodology (M. A. Max-Neef, 1986). The goals included enabling large group participation, reducing costs associated with the coordination and communication of the process, and facilitating participation and discussion.

After completing the design and development of the initial functional prototype of the tool, I travelled to Solferino in the Yucatan Peninsula in Mexico in the summer of 2014 to perform user-

centred, iterative usability testing following Jakob Nielsen's Heuristic Evaluation approach (Nielsen, 2001). The goal was to assess the tool's capacity to meet its intended purpose.

The experience in Solferino was a deeply illuminating and humbling one, which challenged every assumption that I had, made me feel completely inadequate and forced me to rethink all my beliefs about the usefulness or my project and about the role of technology as neutral or as a force to promote equity.

I prepared a poster about this experience and I submitted it to the Global Health Summit organized by the University of Toronto's Dalla Lana School of Public Health (University of Toronto, 2014). My poster was one of four out of 52 selected for oral presentation. Giving a short talk on my experience during the Summit was an amazing and humbling experience.

This project is the culmination of more than two years of work that sought to harness the power of information and communication technologies to promote a more equitable society. Throughout the process of creating and testing an application, and the extensive, critical and sometimes painful reflection motivated by its presentation to rural communities, I have gained an appreciation of the enormous complexity of the environmental challenges we face, of my own biases and prejudices, and how these permeate almost every aspect of our lives.

Chapter 1

Health, Equity and Human Needs

During its constitution, the World Health Organization (WHO) defined health as “a state of complete physical, mental and social well-being and note merely the absence of disease or infirmity” (World Health Organization, 1948). This definition, however, would render most humans “not healthy”, as very few people could claim complete well-being (Jadad & O'Grady, 2008).

An alternative conceptualization of health, proposed by an international group of experts lead by Dr. Alex Jadad, invites us to think of health as “the ability to adapt and to self-manage when facing physical, mental or social challenges” (Huber et al., 2011). As Jadad points out, this alternative frame of mind allows for people to be considered healthy even in the presence of disease (Vogele, 2013).

This way of thinking about health is not meant to replace our efforts to fight diseases. Instead, it offers a complementary point of view, one that reminds us of the importance of resilience, and the fact that the primary factors that shape our health are not medical treatments or lifestyle choices but rather the living conditions we experience. These conditions are now referred to as the “social determinants of health” and they include variables such as income and income distribution, education, food security, housing and healthcare services (Raphael, 2004). In other words, increasing the ability of a community to adapt to socio-economic challenges would likely result not only in increased proportions of people who feel healthy, but also in a reduction in the incidence of disease.

In 2002, Statistics Canada examined predictors of life expectancy, disability-free life expectancy and the presence of fair or poor self-reported health among residents of 136 regions across Canada (Shields & Tremblay, 2002). The predictors included socio-demographic factors

and behavioural factors (i.e. smoking, obesity, infrequent exercise, drinking, high stress and depression). Consistent with most other research, behavioural factors were shown to be “rather weak predictors” of health status compared to socio-economic factors (Diez-Roux, Link, & Northridge, 2000; Lantz et al., 1998; Roux, Merken, & Arnett, 2001).

Income and income inequality are regarded as the most important factors when it comes to being able to predict disease-related outcomes (Raphael, 2004) and this is not only relevant at the end points of the spectrum, there are extraordinary social gradients in health right across society that can be imagined as a ladder with many steps and where people just below the top experience lower health outcomes than people at the top (Wilkinson & Picket, 2011).

When viewing health through this new lens, it becomes easy to appreciate the importance of health inequities, which can be understood as the “potentially avoidable differences in health (or health risks that policy can influence) between groups of people who are more and less advantaged socially; these differences systematically place socially disadvantaged groups at further disadvantage on health” (Braveman & Gruskin, 2003). Health equity is about having a fair chance for all to be healthy.

This approach has a moral and ethical dimension too, as describing a situation as inequitable, would require its cause to be judged to be unfair within the context of the rest of society. Because most of the inequities in health are determined by living and working conditions, attempts to reduce them should focus on improving these conditions (Whitehead, 1990).

Ideally, instead of a prescriptive approach, communities affected by multiple potentially avoidable differences in health should be considered as partners in any effort to identify priority needs, or to set the objectives of any project designed to reduce them. The challenge becomes how to implement this involvement.

An approach to ensure that communities participate in efforts to reduce health disparities focuses on the Human Development Needs framework. Proposed by the Chilean economist

Manfred Max-Neef, this framework emphasizes the ability of a community to define its own needs. Within this approach needs are considered few, non-hierarchical, finite and classifiable and separate from their satisfiers, which are diverse, interrelated and interactive (M. A. Max-Neef, 1986).

Doyal and Gough also consider needs to be finite, in their theory of human need they postulate that the needs of all humans are fundamentally the same and that some modes of social organization are better suited to satisfying these needs than others. Further, they urge us to reject subjectivist and relativist approaches that promote individualism and position the market as the mechanism to satisfy those needs (Doyal, 1991).

More recently, this idea that human needs are universal gained more support based on a study across a sample of 123 countries, which found that needs fulfillment was consistently associated with subjective well-being across the world (Tray & Diener, 2011). Even further, it found that “the emergent ordering of need fulfillment for psychosocial needs were fairly consistent across country conditions”.

In the Human Development Needs Framework the fundamental human needs are captured in a matrix with 36 cells constituted by nine rows corresponding to the distinct categories: subsistence, protection, affection, understanding, participation, leisure, creation, identity and freedom; and four columns corresponding to each of the existential dimensions: being, having, doing and interacting (M. A. Max-Neef, 1986). Figure 1 shows an empty matrix ready to be filled out with satisfiers.

Fundamental Human Needs	Being (qualities)	Having (things)	Doing (actions)	Interacting (settings)
subsistence				
protection				
affection				
understanding				
participation				
leisure				
creation				
identity				
freedom				

Figure 1. Matrix of fundamental human needs (M. A. Max-Neef, 1986)

Notably, there was significant overlap between the subjective well-being study by Tray & Diener and Max-Neef's categories, particularly between "Basic needs" and subsistence, "Safety and security" and protection, "Social support and love" and affection, "Self direction and autonomy" and freedom and "Mastery" and understanding.

The results show consistency across the world in that the same set of basic needs appear to be universal, and that they influence how we evaluate our lives overall, whether we feel respected and autonomous (Tray & Diener, 2011).

Max-Neef's approach is valuable because in addition to describing a theory of human needs, it also outlines a participatory methodology designed specifically to work with groups of people to distil the most destructive factors hindering the realization of their needs as well as their

ideal satisfiers. It also provides a guide to make their aspirations explicit, and suggests a direction to take and the proactive actions that could be pursued to address them (M. A. Max-Neef, 1986).

The methodology was tested initially in 1987 in Bogotá, Colombia, and later in Great Britain, Sweden, Argentina, among many other places. The Colombian study revealed that there might be no correlation between economic growth and the levels of happiness of the people involved (M. Max-Neef, Elizalde, & Hoppenhayn, 2008). This finding was so significant that it lead to a study of 19 different countries, rich and poor, around the world detailing how an “inverted U curve” describes the relationship between economic growth and personal well-being and collective welfare. This study proposed a "Threshold Hypothesis" stating that: “for every society there seems to be a period in which economic growth (as conventionally measured) brings about an improvement in the quality of life, but only up to a point--the threshold point--beyond which, if there is more economic growth, quality of life may begin to deteriorate“ (M. Max-Neef, 1995).

The methodology has even been the inspiration for other fields where gathering requirements is at the core of any project. Alejandro Salado and Roshanak Nilchiani have developed a methodology for gathering requirements for systems engineering deemed “Need-based Categorization” (Salado & Nilchiani, 2014). This methodology places the system at the center and looks to collect requirements by defining “only what the system does, how well , where, and what it uses to accomplish it” this methodology facilitates identification of the most relevant requirements for the system resulting in an optimized set of requirements that reflect highest value for the project stakeholders.

This time tested methodology has served as an effective tool to assess the fundamental needs of communities and its value has been corroborated by successfully repurposing it as a requirements gathering instrument. It constitutes a solid foundation from which to build on and a tangible goal for a technological innovation.

Project Aim

This work seeks to explore the role of a web-based platform to enable rural communities to identify their own needs.

Research question

What are the characteristics of a mobile web-based tool for members of disadvantaged rural communities in the Yucatan Peninsula to facilitate the identification of their unmet fundamental human needs and ideal satisfiers?

For the purposes of this project, the term eHealth "characterizes not only a technical development, but also a state-of-mind, a way of thinking, an attitude, and a commitment for networked, global thinking, to improve health care locally, regionally and worldwide by using information and communication technology" (Eysenbach, 2001) and broadening it so that it applies not only to health care, but to health in a wider sense.

In this new light, web-based tools are not subordinated to the care of disease or limited to focus on the reduction of disease prevalence as their outcome, but on health per se while simultaneously shedding some light on the socio-political changes that are needed to enable every person to have the same opportunity to achieve a healthy and happy life until the last breath.

Chapter 2

Design and Implementation of the application

Design Goals

The design challenge was to translate Max-Neef's methodology for assessing the fundamental human needs of a community from a paper-based process into one supported by a web-based application; to engage people from the community in the evaluation of such platform; and to translate that experience into a refined mobile application that could achieve the same levels of consensus in less time, while including more participants and without the need to congregate in the same physical location.

A secondary goal was to make the application widely available so that as many people as possible around the world could use it to assess the needs of their community with minimal training.

The User Interface

Max-Neef's approach proposes a participatory methodology where participants organize into five or more groups and use sheets of paper to capture, as a group, what they consider negative satisfiers that are hindering the realization of each of the nine fundamental human needs described in the previous chapter. For each of the need categories, participants capture the satisfiers according to the 4 existential dimensions until they have filled all 36 cells. They then designate representatives to eliminate duplicates and synonyms, through a process that usually takes several hours. The following day all the participants distil the unified matrix through a plenary discussion, and create a synthesis matrix containing only one element per cell considered by

consensus to be the most important. The process is repeated again for the ideal satisfiers obtaining a utopian matrix for the community (M. Max-Neef et al., 2008).

In an effort to make the application more intuitive, the decision was made to present the target group of users with a set of components with which they would most likely be familiar. The user interface was created using mobile widgets from the jQuery Mobile framework, which is completely open source and one of the most popular mobile frameworks for web applications (JQuery Foundation, 2014). The widgets also resemble the interface components of well-known mobile operating systems like Apple's iOS and Google's Android.

The application was designed to manage the entire workflow and to rely on only a handful of the simplest components: Labels, Buttons, Lists and Text Input fields. On an Internet-enabled mobile device, a user would open the web browser and navigate to the project's URL (Ros, 2014b). From there, a free account could be created by filling out a short form (Figure 2)

Figure 2. Sign up form

After an account is created, a user can login and is presented with the project's screen (Figure 3). This screen also allows new users to create a new project.

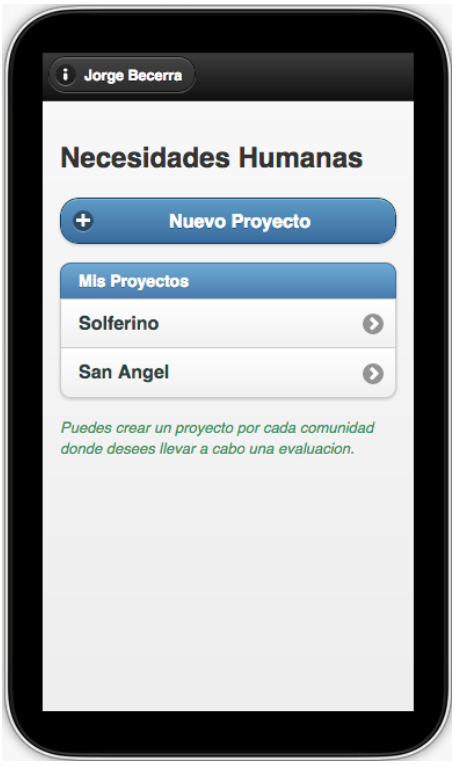


Figure 3. My projects screen

Taping one of the projects in the list causes the application to navigate to the project home screen. The user determines the type and number of matrix to create (e.g., "negative satisfiers" or "ideal satisfiers"). In addition to matrices, a project would contain a number of teams. Each team would consist of a group of people organized by a team coordinator.

An administrator creates the matrices as well as the teams, and provides the team coordinator with a user and a password to access the project. Once the coordinators log in, they will be taken into the project's screen where the project will be listed along with all of its corresponding matrices. Tapping one of the projects will open its home screen.

Figure 4 shows the project home screen using the town of Solferino as an example.

Figure 4. Solferino project home

The team coordinator is then responsible for entering the answers into the system, or assigning a secretary that can complete this task. The teams are given a deadline to submit their answers, and they are free to meet on their own time to discuss and fill in each of the cells of the matrices in the project.

To enter information on the satisfiers into the matrix, the team must choose first a matrix, which will set the theme of the discussion.

Figure 5 shows a list of matrices available within a project.

Figure 5. Available matrices in a project

Once a user selects a matrix, it is possible to choose one of the nine fundamental needs out of a list and then narrow down the selection until getting to the desired cell. This displays the list of items that have already been added by their team to this cell. To add a new item, a user could tap the "new element" button, which would take them to a form containing one free text input field so they can type whatever is on their mind (This was an important consideration because even though it is more complicated than choosing from a list of prefabricated satisfiers, it was decided that the latter would constrain the expression of the participants unnecessarily). Items could be added a concept at a time so that the system can more effectively identify duplicates and synonyms.

A team can add any number of items in each cell without worrying about the activities of other teams. Figure 6 shows the series of screens that a user would go through in order to input an element into a matrix.

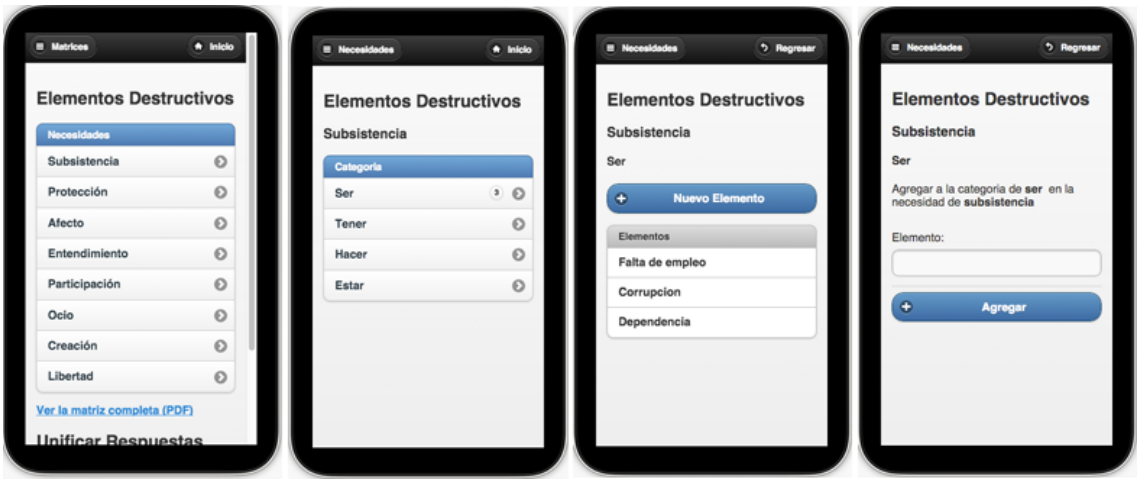


Figure 6. Series of screens to input an element into a matrix

After all the teams have the opportunity to discuss and enter their answers into the system, the administrator logs into the project and runs a unification process. This process combines the different matrices created by each of the teams while comparing items cell by cell and eliminating duplicate words and synonyms in the process. This unification process yields a single list of items per cell considering the input from all the teams, and can be completed within a few minutes, instead of the several hours required with the original methodology where designated participants had to go through the entire process manually.

The automated unification process introduces a limitation in the reach of the system, as it creates a dependency on having access to a dictionary of synonyms in the language of the participants. An alternative is to allow users to decide which words are duplicated and which ones are synonyms, with support from the software. Although this process requires more user interaction than a fully automated unification process, it would still be significantly less time- and effort-intensive than sorting through sheets of paper. It would also eliminate the dependency on dictionaries. Figure 7 shows the placement of the button to unify a matrix.

Figure 7. Button to unify a matrix

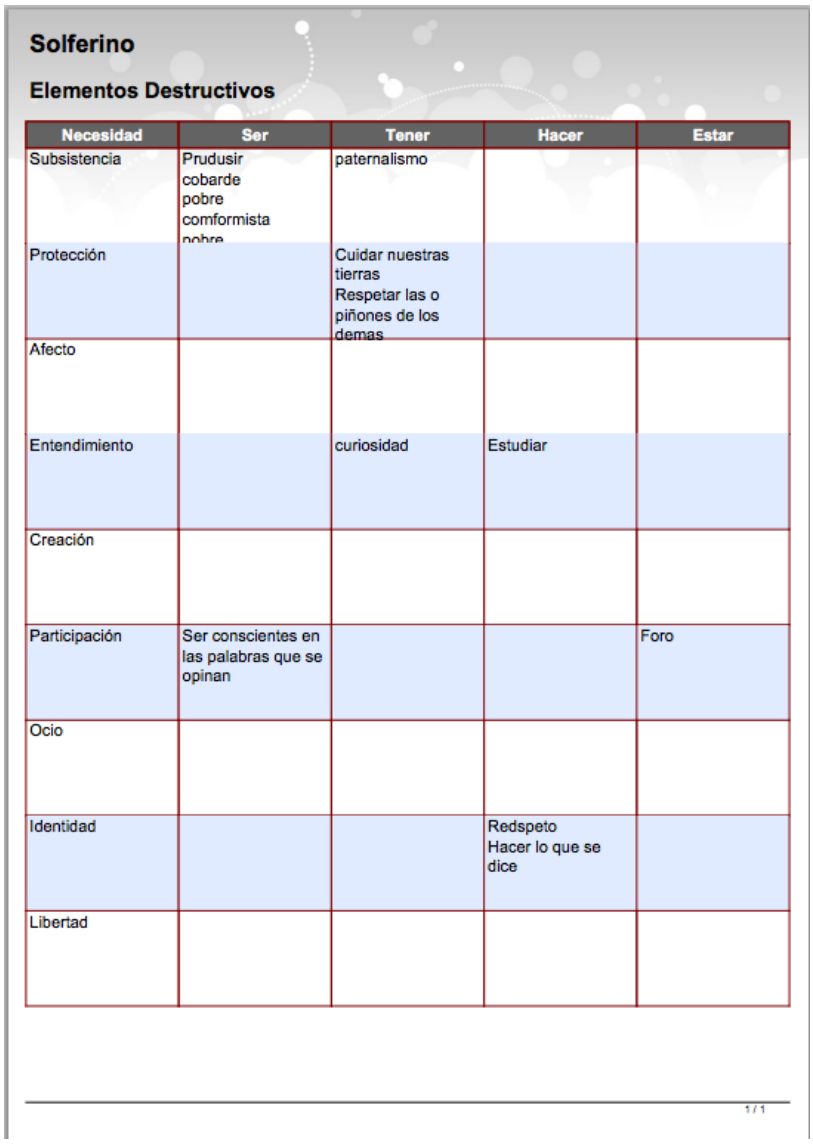
After the matrix is unified, each team meets again to discuss and vote for what they would consider the most important element for each of the four existential categories and each of the nine fundamental needs. Once all the teams have voted, the matrix can be distilled to show the element with the most votes producing the synthesis matrix.

Figure 8 shows the screen where teams vote for one of the items in the unified list for a particular cell in the matrix.

Figure 8. Screen to vote for the most important satisfier within a cell

At any point in the process, any member of the project can export the full matrix, the distilled matrix or the individual matrix for their team, and download it in PDF format in order to print it, email it or share it.

Figure 9 shows a partially filled, undistilled matrix exported as a PDF document.



Solferino

Elementos Destructivos

Necesidad	Ser	Tener	Hacer	Estar
Subsistencia	Prudusir cobarde pobre comformista pobre	paternalismo		
Protección		Cuidar nuestras tierras Respetar las o piñones de los demas		
Afecto				
Entendimiento		curiosidad	Estudiar	
Creación				
Participación	Ser conscientes en las palabras que se opinan			Foro
Ocio				
Identidad			Redspeto Hacer lo que se dice	
Libertad				

1 / 1

Figure 9. Partially filled matrix exported in PDF format

Architecture

To make the platform widely available, a mobile web application based on a client-server model was chosen. A mobile web application meant that most mobile devices with a modern browser would be able to use the tool.

A clear distinction and insulation between the server side and the client side applications was preferred. This separation allows for the creation of multiple client applications that share

server side services such as storing and requesting data, authentication and authorization frameworks, and report generation services and instant messaging.

The client applications and the server communicate via a Representational State Transfer (REST) Application Programmable Interface (API), which is the most widely used type of programmable interface on the web and it is also the easiest to implement in many programming languages (Feng, Shen, & Fan, 2009).

The API aims to be stateless, so every request from the client applications is handled as a separate interaction. This allows the API to be able to adapt to satisfy an ever-increasing usage demand if necessary. Since every request is handled separately, during a typical session a client application could transparently get the data indistinctly from any given server within a cluster. Additionally, if a server crashes, as long as there are other servers available, there would not be a service interruption. Furthermore, servers could be added to the cluster without having to redesign the system to meet a higher demand.

In an attempt to reduce costs of implementation and to enable adoption and remixing of the application, it was decided not only to use open source and freely available technologies whenever possible, but to also make the source code for the application free.

The prototype application was built based on this open source philosophy. The API has been written in PHP 5 (leveraging the symfony framework), the database is powered by MongoDB and it communicates with client applications using the JSON format. The application is currently hosted in an Ubuntu Linux server and served by the Apache web server.

Client applications can be written in any language as long as they are able to perform HTTP requests and can parse JSON data. For this first prototype, the clients is a mobile web application but native mobile and desktop applications could also be built. The mobile web client source code is hosted on github where other people can report issues, make contributions or download it (Ros, 2014a).

For this platform, rich-client applications are needed because in order to keep the server from managing state, the client applications need to manage their own state; they provide all the visual interpretations to the data obtained through the API and they need to handle all user interaction.

It is this first rich, mobile web client prototype that was the focus of the usability test conducted to assess whether the platform would be able to achieve its purpose.

Chapter 3

Solferino: Usability Study

Why Solferino?

Solferino is a small rural community in the Yucatan Peninsula in Mexico. It has a population of approximately 800 inhabitants who are in a large proportion, as it is typical of the region, descendants from the Mayans. Mexico, together with Guatemala, Peru and Bolivia, accounts for 80% of the indigenous populations in Latin America (Vázquez Sandrin & Reyna Bernal, 2011).

Solferino was chosen as the place to perform this usability testing because it embodies the popular perception of a rural community. It evokes images of people living off the land in a more direct and natural way. It is reminiscent of a simpler time and a simpler life style. Although this is often a romanticized and misinformed vision of rural communities, which are actually quite diverse and on average differ more from one another than urban areas do (Flora & Flora, 2012), Solferino comes close.

From a health equity point of view, based on the social determinants for disease reduction there are several important dimensions that would put Solferino at a high risk for disease, and for widespread self-perceptions of poor or fair health.

Despite its vast natural resources, the region has been identified as the most unequal in the world (United Nations Development Programme, 2010). Mexico is one of the most unequal countries in the continent (OECD, 2014). The Yucatan Peninsula, in turn, is part of the rural south, which is the region with the greatest concentration of indigenous people and it is the most marginalized in the country (Vázquez Sandrin, 2011).

The evidence of health inequity among indigenous people is clear. Their life expectancy is estimated as 10 years less than non-indigenous populations, their risk of death from pulmonary

tuberculosis is almost twice as high, and their infant mortality is 58% higher (Haro, 2011). Poor nutrition throughout an individual's life and in particular during childhood is in turn one of the main determinants of health, and productivity (Vázquez Sandrin, 2011).

When considering that Solferino is rural, studies have shown in other parts of the world have shown that poverty rates of rural families headed by single mothers are high (43% all races, 49% blacks alone and 53% hispanics alone) (U.S. Bureau of the Census, 2006); furthermore affordable day care generally is not available; and the rural poor are much more likely to live in mobile homes than their urban counterparts. Knowing the importance of access to education, good jobs, day care and appropriate housing makes rural communities especially vulnerable to disease.

Many rural communities have a very high proportion of elderly (Flora & Flora, 2012), which likely means that chronic diseases are becoming a top concern. There is also a shortage of rural physicians, with only 10% of them practicing in non-metro areas although 20 percent of the population resides there (Moody, 2002).

In Canada, generally rural residents are more likely to be in poorer socio-economic conditions, to have lower education, to exhibit less healthy behaviours and to have higher overall mortality rates than urban residents. For men for example, life expectancy was higher in areas with strong metropolitan influence (77.4 years) than in areas with no metropolitan influence (74.0 years). Also lack of metropolitan influence increases the risk for circulatory disease mortality with the ratios for moderate, weak and no influence respectively being 1.07, 1.06 and 1.10 in comparison with urban figures (DesMeules & Pong, 2006).

In Yucatan, the prevalence of tuberculosis is related to social determinants like extreme poverty, poor nutrition, marginalization of neighborhoods and insufficient hygiene. Local researchers Heredia-Navarrete et al. reiterate that in order to confront the disease it is imperative to

intervene not only from the clinical point of view but also political and social (Heredia-Navarrete, Puc-Franco, Caamal-Ley, & Vargas-González, 2012).

The combination of these indicators suggested that Solferino would be in a good position to benefit from this project if the technology could deliver its promise.

The Usability Evaluation

After completing the design and development of the initial functional prototype of the tool, I travelled to Solferino to perform user-centred, iterative usability testing following Jakob Nielsen's Heuristic Evaluation technique (Nielsen & Molich, 1990). For this type of usability test a small group of evaluators examine the interface and qualify how well it performs against a list of recognized usability principles. The number of evaluators is not determined until saturation is reach –when no new issues are reported during an evaluation, typically 5 evaluators is sufficient but at least 3 are recommended (Nielsen, 2001).

Methodology

Participants were contacted and recruited at their homes in Solferino with the help of a local contact who knew the community. Whenever possible the appointment was arranged ahead of time over the phone. However, when this was not possible the test administrator would show up unannounced at the participant's home, sometimes forced to come back on a different day. The purpose of the visit, the nature of their participation and duration of the engagement was explained so that participants could opt to participate or not in the evaluation. The sessions lasted from 20 minutes to an hour depending on the role of the participant in the application.

To start the session the purpose of the application was explained and participants were guided at a very high level though Max-Neef's methodology (adapted for the mobile-web application) including the concept of the matrix of needs and satisfiers, the different user roles in the system and the formation of teams. Participants were handed a mobile device with the application already loaded and were instructed to go through the entire interface available (dependant on their role) and to report verbally anything that they considered a problem or limitation or anything they did not understand.

During this time the test administrator observed the interactions of the participant with the application and answered any questions while making notes. After the evaluation was concluded and all the feedback was collected it was compared to the heuristic principles and logged into a table.

At the end of the evaluation each participant was asked to complete the Computer Systems Usability Questionnaire (Lewis, 1995), which is constituted of 19 questions using a sliding scale of 1 to 7 points from strongly disagree to strongly agree. Six out of nine participants (66%) filled in the questionnaire themselves whereas the other three preferred someone else to read the questions for them and they would respond verbally with a number from one to seven to indicate their answer.

Participants

Two types of users were chosen based on their role in the community. Those who were identified by the local contact as community leaders completed the evaluation as a "project administrator" while the rest of the participants complete it as "team coordinator". The project administrator tasks included creating a new project, new matrices and teams, and entering

satisfiers into a matrix. The team coordinator tasks, in contrast, were simplified to entering satisfiers into a matrix.

Figure 11 shows an evaluator during an assessment of the application.

Figure 11. Evaluator conducting the heuristic evaluation

In total nine participants completed the evaluation. Saturation was achieved at five participants for the project administrators and four participants for the team coordinators. Three participants conducted evaluations on August 30th, 2014, two more on August 31st 2014, and four on September 3rd 2014. There were four female participants: three of them were project administrators, and one was a team coordinator. Five participants were male, including two who were project administrators, and three who were project coordinators (Table 1).

	Project Administrator	Team Coordinator
Male	2	3
Female	3	1

Table 1. Participants divided by role and gender

Results

All participants completed the heuristic evaluation with the help of the test administrator. Seven out of the nine (88%) experienced difficulty using the list widgets chosen to navigate the application, a crucial feature in order to understand its workflow. Quite often they did not know how to move to the next screen or how to go back and became stuck. Six (66%) mentioned specifically that they would have liked to have a human being who would have explained how the application should be used. Five felt that the language used both in the application and by the test administrator was too technical (55%) and the same number of participants experienced difficulty navigating back to the project home. Four (44%) Did not know how to enter text into a text box and 44% of the sessions reported that the internet was too slow to be usable.

Figure 10 depicts the top usability problems described by each of the evaluators. Each row in figure 10 represents a usability problem and each column represents an evaluator. The cells with a number 1 in it and shaded in grey indicate that that particular evaluator reported the usability problem.

	JEMC	AM	MDV	MGAP	MJA	AL	MR	IB	FFM	
Lists don't look clickable		1	1	1	1	1	1	1	1	8
Insufficient Guide	1				1	1	1	1	1	6
Language was too technical		1	1	1			1	1		5
Navigating back to the project was complicated	1		1	1		1		1		5
Didn't know how to enter text into the text box	1			1	1				1	4
Internet was very slow						1	1	1	1	4
Notify when there is an error						1	1	1	1	4
Didn't know how to start from the landing page			1					1	1	3
Didn't know how to tap a button				1	1				1	3
Can't edit answers		1				1	1			3
Rotating the phone caused the interface to scale and not fit on the screen							1		1	2
Too much text, hard to find the option one is looking for						1		1		2
Auto-correct modifed text without user noticing			1					1		2
Screen locked due to inactivity would not know how to get back to app									1	1
Fat fingers									1	1
Can't delete answers		1								1
Refreshing the browser doesn't bring you back to where you were						1				1
Confirmation not provided after completing actions							1			1
Roles of different users not clear							1			1
Hard to keep track which project/matrix elements were being added to								1		1
Didn't know how to scroll the screen					1					1
	3	4	5	5	5	8	9	10	10	

Figure 10. Most reported usability problems

The usability principle or heuristic that was most often dishonoured in the sessions based on the evaluators report was the match between the system and real world. According to Nielsen, the "system should speak the users' language, with words, phrases and concepts familiar to the user" (Nielsen & Molich, 1990). All of the participants reported at least one issue related to a mismatch or disconnection between the real world and the system. Ten out of the twenty one (47%) of the usability issues reported was related to an incompatibility in language or representations used and the participant's expectations or previous knowledge making the application unnatural to use. Four usability issues (19%) were related to user control and freedom. Five out of nine participants (55%) reported at least one issue related to navigating or finding their place in the application. Three usability issues (14%) were related to poor visibility of the system status affecting four out of nine participants (44%). One issue (4%) was also reported

for each of Error prevention, Aesthetic and minimalist design and Help and documentation principles respectively.

Errors

The application did not recover gracefully from connectivity errors, which rendered the application unusable with no indication to the participant that the connection had been lost in four out of nine sessions (44%). Three participants (33%) tried to edit their answer and one (11%) tried to delete an answer and realized that the application did not provide this functionality.

Computer Systems Usability Questionnaire

The average of the answers across all evaluators was above five points, appearing as if all participants agreed or strongly agreed that the application overall was easy to use. This result was surprising as it did not correspond to the test administrator's observations and usability issues these evaluators reported during their assessment of the application and would seem to reflect politeness, lack of understanding of the questionnaire or indifference.

Table 2 shows the average level of agreement with each of the statements in the questionnaire.

Question	Average
Overall, I am satisfied with how easy it is to use this system	5.78
It was simple to use this system	5.89
I can effectively complete my work using this system	6.11
I am able to complete my work quickly using this system	6.22
I am able to efficiently complete my work using this system	5.56
I feel comfortable using this system	6.56
It was easy to learn to use this system	5.33
I believe I became productive quickly using this system	6.67
The system gives error messages that clearly tell me how to fix problems	5.44
Whenever I make a mistake using the system, I recover easily and quickly	5.89

The information (such as online help, on-screen messages, and other documentation) provided with this system is clear	5.56
It is easy to find the information I needed	6.11
The information provided for the system is easy to understand	5.67
The information is effective in helping me complete the tasks and scenarios	5.89
The organization of information on the system screens is clear	5.67
The interface of this system is pleasant	6.67
I like using the interface of this system	6.33
This system has all the functions and capabilities I expect it to have	5.89
Overall, I am satisfied with this system	5.89

Table 2. Average agreement per question

The questionnaire also offered an opportunity for the participants to express in their own words up to three aspects they believe to be the most negative and positive of the application. Most participants only entered one or two aspects and some participants chose to not enter anything at all. Their feedback was translated from Spanish, and is included in Tables 3 and 4.

Most Negative
Needs more instructions
Uses internet in rural communities
Need to be able to edit answers
Needs feature to set objectives and track progress of them
Wording is difficult to comprehend
Internet was really slow
Very technical
Fingers too fat for touch keys
Screen is blocked after inactivity. Don't know how to get it back
At the beginning it was difficult to understand how to type

Table 3. Most negative aspects identified by participants

Most Positive
Satisfies a basic need
Supports work that normally takes a long time to do
Clarifies ideas, needs and directions to follow
Organization
Facilitates the operation in a work centre
Easy access
It is very easy once you are confident on how to type
It can help so that people can take advantage of this medium

Table 4. Most positive aspects identified by participants

Participants' comments and observations

A comprehensive list of all the experiences during this usability test was compiled (see Appendix). This section highlights the experiences that revealed main assumptions I made and the implications for my own understanding and for other researchers interested in promoting health equity in rural communities.

The participants repeatedly indicated that the language used was "too technical", this applied both to the graphical interface of the application and the way I described its purpose and how to use it. I had assumed that everybody knew what the concepts of matrix and fundamental human need were, and that the methodology I was following could be understood and exploited without significant adaptation or training by members of a rural community. I also assumed that because Spanish is my native language, I could communicate clearly and that I was good at explaining concepts related to the use of ICTs and the identification of human needs.

I had assumed that I knew more about technology and connectivity than all of them. I thought I was prepared by bringing four Internet-enabled mobile devices, two of them with a Canadian data plan, and the other two with a Mexican provider. I also managed to bring with me two 3G modems that were from a local carrier. However, in most of Solferino the cellular signal is so poor that there is no connection at all most of the time. There is only one house in the entire town that has Internet access. Yet, everyone in Solferino knows that in order to get a good signal it is necessary to go "under the Ceiba tree". This huge tree apparently acts like a kind of antenna, so whenever someone from Solferino needs to make a phone call, they go there.

At the end of the usability test, I had the sinking feeling that most people did not understand at all the project, or what I was trying to test. It was clear that they needed help to grasp what I had built. Even after explaining it, most of them require step by step instructions and

kept asking questions like “what should I tap now?” or were visibly puzzled when were instructed to “choose the matrix you would like to fill in”, even though the list of matrices was loaded in their screen at the time. In later evaluations, I tried to adjust my language and use terms like “table” instead of “matrix” but the experience was essentially the same.

Some people seemed uninterested and apathetic. At least one participant made it obvious that was not interested at all in the usability questionnaire requesting to be read the questions out loud and then randomly alternating the answers from 4 to 7. Another being polite just said 7 to every statement. I had assumed that what I was presenting was of interest to them and had value, that there was currently a problem, which I had identified and they had not thought about and it would be clear to everyone once I explained it. I had assumed that their health was worse than mine, that they were disadvantaged and needed my help, and that my understanding of the conceptual aspects of health was more profound and sophisticated than theirs. Therefore I assumed that I had the responsibility to persuade them to see things my way. They might be at higher risk of disease according to the social determinants of health. However, I realize now that I do not know enough about their ability to adapt and self-manage in the face of the challenges they have and that it is within the range of possibilities that they can do this much more effectively than I can.

Discussion

The experience in Solferino was very frustrating, humbling and downright embarrassing to me. These feelings led to deep introspection and to the discovery of many painful and dangerous assumptions that were invisible to me in the role of researcher.

First, I assumed that I was going to be received with open arms like some kind of saviour. I had heard about other people acting in this way and I had been part of many discussions around

this topic before. However, I always thought I would never behave like that; I thought I knew better. I thought that having been born in the same country and raised in a rural community myself provided me with an understanding of what the experience of the people of Solferino. I also felt that they would see me as one of them -one that had gone abroad, received superior education and had come back to share with them all that knowledge. Instead I had an intense feeling of being a foreigner, a stranger who did not belong and did not understand them.

I believed the application was easy to use, that there was a common lower denominator when it comes to experience with user interface components and that it was obvious how to use the controls that I had chosen for the interface. I was shocked to see that some people did not know how to interact with a button or how to enter text into a field. In retrospect, it is obvious that for someone who has never used a touchscreen device, the interface would not be intuitive. How could anyone know that it is necessary to tap on a grey box that makes an input field in order to get the keyboard to pop up from the bottom of the screen? I thought I was good at putting people first when designing information technology.

I realize now that I was unknowingly trying to mould their lives to my expectations and guidelines. I was trying to homogenize their experience by creating an application that could be generalized so that it would be useful for any community around the world. I was looking for a way to automate the gathering of data, to represent their needs, and to make the process more efficient by turning to standardization and abstraction. I believed that technology was inherently good, and thought that by making it available to them, I thought, they would benefit from it. I did not consider that my project could be unnecessary, that there could be better alternatives to elicit their needs, or that it could do more harm than good.

I had assumed that I knew myself and that I was free of biases and prejudices, that I understood and valued diversity, that I was sensitive to cultural differences, and that I did not

promote colonial ideas or relationships. I thought I could trust myself to know what was better for the community.

I was wrong.

My main conclusion is that developing eHealth innovations that seek to promote equity among members of marginalized communities requires efforts to involve them as partners at all stages of the project, from the formulation of the question and the identification of objectives, through the design and refinement of the intervention, to data collection and analysis.

Members of marginalized rural communities should be involved in the innovation process as co-creators of the interventions that are meant to improve their lives. They should also be regarded as reverse mentors for researchers coming from resource-rich environments.

Only through deep respect for the community, and humility, researchers like me will have the privilege to develop a strong sense of trust, and to enjoy the power of collective agency (Flora & Flora, 2012), to maximize the ability to tackle common social problems, together.

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Appendix

Reflections on hidden assumptions

Experience	Hidden Assumption	So what?
I was told repeatedly that the language I was using was too technical	Everybody knows the meaning of a matrix and fundamental human needs	Make sure you use unambiguous terms that are locally appropriate. For example the word "equipo" in Spanish can mean team or equipment, if you are referring to a group of people it might be preferable to use the word "grupo" (group), which has a clearer meaning. Whenever possible sacrifice accuracy for ease of understanding, i.e. table instead of matrix
	The methodology I chose can be understood and exploited without significant adaptation or training by members of a rural community	Get to know your target community ahead of time and always consider not only whether what you are proposing is a good fit but also whether you need to adapt it to the local environment. Include in your rationale factors like, language, literacy level, lifestyle, preferences, inclinations and dispositions
	Spanish is my native language. Therefore, I should have no problem communicating with people living in rural communities in Mexico	Even if you, in principle, speak the same language of the community you want to visit, if you have an academic or professional background or even if you come from a different region, the words you use will likely be different than the ones the local community uses. Keep in mind that this does not mean your words are better. Make an effort to understand ahead of time the colloquial language of the region you are visiting, and try to use local terms whenever explaining concepts
	I am good at explaining things	Do not assume it is the fault of community members when they do not understand something. Are there any concepts you need to unpack? Are you speaking their language?

The application was often unusably slow	If I bring several mobile devices with data plans and 3G modems from a local carrier, I should be able to connect to the Internet. After all, we are only a couple of hours away from the city of Cancun	Relying on specific infrastructure can be a sure source of frustration both for your and for the people you are working with in a remote community. Whenever possible, develop several backup plans in case you cannot get access to certain resources. An even better alternative is to build into your project the ability to adapt so that it can work and be useful without access to those resources
Everyone in the community knew that in order to get good cellular signal it is necessary to go “under the Ceiba tree”	I know more about technology and connectivity than all of "them"	Consult with local people as much as you can. They live there, they are the experts of what works and does not work there. Even if it is related to a subject where you consider yourself to be knowledgeable, keep in mind that the context will be different in remote areas especially in other countries, provinces or territories
At the end of the usability test I have the sinking feeling that most people did not even understand the purpose of the application	As soon as I show them what I have done, they are all going to immediately understand what I have designed and see how they could benefit from it	You have worked on your project likely for many months, digested it and made sense of it over and over again, compacting the information into logical chunks. You have convinced yourself that it is useful and that it has a valid purpose. Assuming you are right can be a non-obvious pitfall, but even if you were right, to have people capture it all on the first time you talk to them is expecting too much from anyone. Be humble and be prepared to admit that you do not know what is best for them and that spending time with them should be a two-way conversation, an exchange of ideas. You are not there to impart wisdom
Some people seemed uninterested and apathetic	People are going to receive me with open arms	To show up as a foreigner, and expect to be welcomed and treated like royalty is disrespectful. Consider that they are taking time out of their own day to talk to you and explain how they go about doing things. Would you take time out of your day to help them with their research agenda if they came to your house?
	What I want to discuss is	How much do you really know about

	of interest to them	what is of interest to them? Do you know what their concerns and aspirations are? How can you generalize the experience of a population no matter how small or remote? Chances are your preconceptions are not accurate. Be prepared for rejection or at least for indifference. Some people may be enthusiastic about meeting new people and hearing new ideas, but some are tired of being studied and pitched one idea after another from people that come from outside their community, and do not even understand what is like to live there
	There is currently a problem, which I have identified. It will be clear to everyone once I explain it why it is important to remedy it	Why do you think there is a problem? If it is a problem where you live does not mean it automatically is a problem there. Different cultures, and even different people from the same background, value different things. Pay special interest to non-material or financial wealth. Not having something that you have is not necessarily a problem or a sign of poverty. Sometimes even things that would seem obviously problematic to you, if viewed from another angle, could prove to have a positive aspect to them
	They have not thought about what I am bringing forward	There is the possibility that they have already considered what you are about to discuss with them and they might have already decided that it was not worth pursuing it. Also, if they have not considered it, it does not necessarily mean that it is because they have a more limited vision than you do. Consider that each person would have a different vantage point and different things can be appreciated from them. Your observations might be of value to them but they might also be irrelevant, in the same way you should consider their observations with an open mind

	What I have created has value for them	You will not be able to know if you have created something valuable to anybody until they let you know otherwise. Always take an exploratory stance and be willing to learn from everyone. Ideally, work with community members as your partners, able to co-create the intervention with you. Where exactly is the value coming from? Could this same or a similar value be extracted by another, cheaper, more local initiative? What side effects come with the value you think you would be creating? Who benefits?
	"They" are disadvantaged and need my help	There are many ways of living. It is very easy to assume that the way you live -regardless of specifics- is the best. We are quick to assume that someone that has less material possessions, does not speak our language, does not look like us or believes something different than us is 'disadvantaged'. We should be extremely alert about our internal systems, which are constantly trying to mould the surroundings to us, even in situations where it is us who should be moulding to fit our surroundings
	Their health is worse than ours, as we live in places with more material resources and better access to technology	This really depends on how you define health. Life expectancy or presence of disease can be measured but there are other factors especially if we are looking through a salutogenic approach. And then there is also their ability to adapt and self-manage when facing physical, mental or social challenges. At any rate, even with the most traditional definitions of health they could be healthier than you. What if you asked them about how healthy they feel? Are you familiar with their diet, their exercise levels, their social relationships and bonds, their sense of belonging to a community or their happiness levels? Are you truly free

		to manage your own life? Are you debt free? How much time do you spend sitting in front of a computer/TV/video game console? How much time do you spend at a job you do not like?
	It is worth their time to pay attention to me and what I am proposing	Be careful about feeling like you are the expert and they should listen to you. How is your expertise relevant to them? Why should they pay attention to you? What afforded you their attention? Again, be humble and approach the community with a sense of listening to *them* instead. Invite them to become your partners, and to influence the objectives of the project and to shape the intervention. What can you learn from them? How can you make your project relevant to them? Approaching a community with a 'proposal' without ever having lived there is very short sighted. Aim to improve your understanding not to illuminate others
It was very difficult to persuade people to think about human needs within the framework I was using	Once I explain how the framework works, it will be clear to people what it accomplishes and how they can use it	Stubbornly attempting to persuade people to see things your way, particularly when you are talking about something new that a few minutes ago was not even a concern for them, is an act of violence. Instead of attempting to impose your views on someone else, try to adapt your ideas to their conceptual frameworks, try to see if they fit and be ready to accept that they might not fit and your idea might not be the best idea for a particular community. Invite them to become your partners
	I should persuade people to see things the way I understand them	
	My understanding of these concepts is more sophisticated and profound than theirs	You cannot know what other people know, particularly in a community where you have never been before. Furthermore, there are different ways of knowing. Some people might have not gone to school or have any kind of professional training but they could be very informed about a topic using their common sense, or by reading about it. We live in a time where

		information is ubiquitous
I felt that what I had built was inadequate and impractical for them	If I read enough and apply myself, I can develop a tool that can make people's lives better	How can you build something to make people's lives better without knowing what people need? Reading a lot and applying yourself, if you do not involve others, is the equivalent of working in a silo. It is simply not realistic to think that something you build on your own will be able to create value for the people who would use it. What do they need? Is such need something that can be even aided by building something? Is it up to you to come up with a solution?
	Technology is inherently good and if I just make it accessible to people they will benefit from it	Technology in many cases can unlock mysteries, give us more free time, make a process simpler and transform the way we look at the world. Having access to a technology can alter the power balance within human relationships, by providing the person who has access with an advantage or opportunity. Throughout history, whenever one of us has had an advantage over another, we tend to use it to improve our position to the detriment of the other. So it could be argued that technology will always have the potential to be a source of inequity. This is particularly true in a capitalist world where capital can restrict access to those technologies for profit. Aside from this overarching consideration, even if you set out to create technology specifically for those who are disadvantaged, it is extremely difficult to predict the side effects that access to that technology

		might have. Perhaps access to a mobile device could make people more sedentary, less involved in their communities and therefore less healthy. If we managed to create a great technology that would solve a large problem, that would make our lives easier, and we managed to avoid the temptation of profiting from it by giving it away freely and if we succeeded in implementing it, what would be the consequences?
	I can develop technology that will feel like it was created specifically for them by following my instincts	It is questionable whether you can actually create technology that would feel that it was created specifically for someone. It is much harder to be able to assert that such task can be accomplished by following one's instincts. The way technology is built to someone's satisfaction is typically by following a series of quick iterations in which the stakeholders and the end users are continuously involved by providing guidance and feedback at every step of the way
	Technology is not loaded with homogenizing practices	The translation from an artisanal process to an industrial process would almost invariably bring with it an efficiency gain at the cost of standardization. Technological solutions are often focused on simplifying processes to make them more efficient, hence require more homogeneous inputs.
	Using information technology I can improve the methodology that was created using paper sheets and pencils	There are many trade-offs that need to be considered when adapting a methodology that was designed to work in the physical world to a digital device. For example, writing or drawing freehand with a pencil in a piece of paper is vastly more accessible than drawing/writing/typing into a touch screen device. The pencil is more familiar to hold (it is more likely at the time of this writing that someone has held a pencil before than a touch-screen device). A piece of paper is

		less intimidating; it doesn't run out of battery. If there is no pencil or paper, then a stick and the soil can be used to draw or write as well
I felt like a foreigner and an outsider	Since I was born in Mexico, they will automatically think that I am one of them and as such they will accept me	People are different from one neighbourhood to the next or from one block to the next. They change over time. What at one point was familiar to you can become foreign. As your experiences start to differ from those of others, your worldview will also change. You can live in a community your whole life and still feel like a foreigner. You can approach your own community, your family and your friends and still have no guarantee that they will accept your ideas or consider them valuable Once again, humility and a keen interest to learn from people will be your best ally to feel accepted in their group
There was a generalized fear to appear weak or dumb in front of me - before starting the test when I handed them the device many would say something like "But, I've never used one of these before" or "Does it matter that I don't know much about these things at all" or "Just so you know, I am not very good with technology"	I can create a friendly and comfortable environment where people do not feel judged and can express their opinions freely about the tool I have created	Creating a friendly environment for people to express their opinions is very challenging, particularly if they feel they can offend you or that they will be ridiculed or criticized. It is up to you to strive to create the proper environment, without underestimating the complexity of this task, or trusting that it will happen naturally. Make a conscious effort to make people comfortable
I felt like a coward seeking refuge in homogenizing other people's realities to conform to mine	I can be objective and unbiased	We all carry our own biases and it is extremely difficult to set them aside when we are analyzing any particular scenario. The more you are aware of your own biases the better prepared you will be when trying to generate new knowledge. Pretending or feeling that you are free from bias will jeopardize your research
	I am sensitive to cultural differences	Being sensitive to cultural differences is one thing. Being confident that you can go into any culture and understand it and fit in is quite
	I understand the value of diversity	

	I don't promote colonial ideas or relationships	another and can potentially mean you are not being sensitive at all to that particular culture. It is a bit like being humble. The moment you feel like you are being humble you are probably not humble enough. The same goes for placing value in diversity and making sure that your actions do not reinforce colonial ideas. The challenge is that the status quo is filled with ideology, colonial relationships, power imbalances and homogenizing tendencies and it is very easy to fall back into it, particularly if you are comfortable because you are the recipient of privilege in one form or another
	I can understand other people's reality from afar	Understanding someone else's reality is very difficult to do. In fact, it might be impossible to do. It is hard to even understand our own reality or that of those closest to us. How can we expect to understand what it is like to be someone else living in a context that is completely different from ours, raised in a different culture, from a different gender, different language, different age, traditions, dreams, frustrations, setbacks, accomplishments, responsibilities? The list could go on and on. It is simply not possible to understand someone else's experience. We should try to get as close as possible and you simply cannot do that behind a desk, reading a book or considering others as inferior, or just as “subjects”
More than one person had never seen or held in their hand a touchscreen device	Connected devices are so widespread in the region that even if not every single person has one, within a small group of people someone will have one	See my previous comment about relying on specific infrastructure.
There was only one person with internet at home in the whole community		
Most people had difficulty navigating using a common lists of options (didn't think	It is obvious how to use the UI controls that I am including in the interface. I	There are certain things that within a particular culture might be so widespread that everybody has

they could touch one to "enter" that section)	am using industry standard widgets and therefore should be universally familiar. Everyone has a minimum baseline understanding of software interfaces	accepted them. They can appear to be part of a universal truth or in the popular domain. When visiting a different community, try to analyze everything that you would consider a common lower denominator and challenge your assumptions. It can seem silly sometimes, but to those who have never seen a lock, the concept of a key would not cross their minds. Think about which aspects of your project can be locks and who you are locking out
More than one person did not know how to enter text into a text field in a mobile device (they did not know the keyboard would pop up automatically)		
More than one person did not feel they could tap on a button (or were afraid of what would happen)		
It was not obvious that you could scroll the screen by dragging it with your finger		
Some people had difficulty tapping on an element without dragging the screen		
Almost everyone mentioned that they would like someone to explain to them how the application works	I can create an application that is intuitive and easy enough to use that anybody can pick it up and start using it	Consider the importance of human-to-human interaction. Create the easiest-to-use interface possible. Also, consider the need for a human to explain it to those who would have never seen a software interface of that kind
	If I include a guide with written instructions people will read it if they have a question of how to use the application	It is a known fact that users do not read instructions. However, it is always tempting to include text explaining what the interface should do. Consider making a short video instead, or include a human facilitator whenever possible
	It is easy to find the guide in the application	Users expect the application to just work. They have tunnel vision and they might not notice the help button
After I explained individually how to use the application and the individual UI controls most people had no problem using it	One of the design goals is that people can use the tool without any need for explanations.	As noble as this goal sounds, this might not be an attainable goal for many target audiences. Whenever something is easy to use, it is usually because of a prior knowledge that is being leveraged in the interface to make it conform to the users' expectations. On many occasions, the use of metaphors can help. By relating to something already familiar to the user, the learning curve can be reduced. Some examples of this

		include the concepts of desktop, folders and files in operating systems. But what happens when you find someone that is not familiar with the object on which you are basing your metaphor? Would an operating system be easy to use to someone that has never seen a desktop or a folder?
I realized that I could not implement a successful intervention without a human facilitator	A human facilitator is undesirable because it limits the reach of the application	Why do we assume that achieving scalability is important? This idea is rooted in the business world and once again it is based on efficiencies gained by standardizing. Unfortunately this trade-off rears its ugly head once again. You can create an application that is very scalable and can reach millions of people, but chances are you would be dehumanizing people
People seemed uncomfortable with a faceless technology coordinating and mediating their interactions	I understand how to always put people first when designing technology	This is one of the areas where the conflict between the artisanal and the industrial approach makes itself apparent. You can put people first by always thinking about them when designing an application, and start your design based on people. However, it is probably not practical to think of the particulars of every single individual that would use the application. Once again, you risk ending up homogenizing the community to reduce complexity, hoping to serve a wider audience
	The data that can be collected matters most	The data are important. However, it is essential to keep in mind that no matter how much data you can collect from people, such data will never be able to tell their full story. Digital information by definition turns information into discreet bits, which obscure the analog fidelity associated with them. The data you can collect from someone are an abstraction and as much as they can be a useful representation of someone's tastes, opinions or buying patterns, they will never capture who that individual

		truly is
	Being able to scale the application is a central goal of the project	It is easy to believe that the worth of something is directly linked to the number of people that can benefit from it. This is clearly true to an extent, but before defaulting to thinking that everything needs to be as large scale as possible, consider that as the cumulative value of the project grows by reaching more individuals, the value that each individual will extract would diminish
	The data can speak for people	In this age of “datification”, it is possible to gain very valuable insights from data. Big data techniques allow us to see patterns that we could have never seen before. Although the data we collect could often provide accurate predictions of people’s preferences, always consider that qualitative approaches to capture individual views could yield a very different picture